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(54) Appareil pour la coupe et les soins des cheveux.

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(56) Documents cités:
DE - A - 2 107 951
DE - B - 1 137 253
FR - A - 903 526
FR - A - 2 251 422
US - A - 2 386 409
US - A - 2 856 683

EP 0 102 289 B1

Description

La présente invention concerne un appareil pour la coupe des cheveux, et plus particulièrement un appareil assurant à la fois la coupe et les soins des cheveux.

On connait divers appareils ou accessoires destinés à la coupe ou aux soins des cheveux. Les appareils de coupe sont le plus souvent constitués par des ciseaux dont la structure peut être plus ou moins complexe, ou des rasoirs, actionnés mécaniquement ou électriquement. Toutefois tous ces dispositifs connus assurent uniquement la coupe des cheveux, tandis que les soins ou traitements doivent être apportés séparément.

Par ailleurs, on sait qu'il peut être avantageux de soigner certains cheveux par brûlage ou par effilage, et plus particulièrement on connait des techniques très anciennes consistant à traiter des cheveux par brûlage à la flamme d'une bougie. Le brevet français 903 526 décrit un dispositif destiné au brûlage de l'extrémité des cheveux au moyen d'une résistance électrique combinée à un peigne, mais ce dispositif ne peut procurer des résultats satisfaisants pour la coupe et le soin des cheveux. Le brevet allemand 2.107.951 décrit un appareil à fil chauffant dont la dilatation n'est pas compensée. Par contre le brevet US-A-2 386 409 décrit un appareil à fil chauffant dont la dilatation est compensée.

Ainsi, on ne dispose d'aucun appareil permettant d'assurer dans de bonnes conditions de sécurité et d'efficacité, à la fois la coupe des cheveux et leurs soins par la technique du brûlage.

La présente invention a donc pour objet un appareil permettant d'assurer la coupe et le brûlage des cheveux dans d'excellentes conditions de sécurité et d'efficacité.

L'invention a également pour objet un appareil du coupe et soins des cheveux par brûlage, de constitution simple et de fabrication aisée et peu coûteuse.

La présente invention a encore pour objet un appareil perfectionné du type décrit ci-dessus, permettant la coupe et le soin des cheveux dans de bonnes conditions, dans lequel le fil est efficacement maintenu en place, assurant un excellent contact électrique, et peut être changé aisément.

L'appareil pour la coupe et les soins des cheveux par brûlage conforme à la présente invention comporte un fil ou une lame métallique susceptible d'être porté à incandescence, à une température d'environ 700 à 1000°C, de longueur comprise entre 3 et 20 cm environ, maintenu à chacune de ses extrémités par deux attaches solidaires d'un support, dont l'une au moins est flexible et assure une tension sensiblement constante du fil ou de la lame quelle que soit sa température.

Le fil ou la lame métallique est monté parallèlement au support, à une distance de celui-ci comprise entre 0,5 et 4 cm environ, et de préférence entre 1 et 1,5 cm. Le fil peut être constitué par tout fil d'acier ou d'alliage de diamètre compris entre 0,1 et 0,8 mm et de préférence entre 0,3 et 0,4 mm, de longueur comprise entre 3 et 20 cm environ. Dans le cas d'une lame métallique, la longueur est la même, l'épaisseur de la lame est comprise entre 0,1 et 0,3 mm et sa largeur est de préférence d'environ 1 mm, mais peut être le cas échéant de l'ordre de quelques millimètres.

La lame ou le fil est de préférence en un alliage, par exemple un alliage nickel-chrome, du type utilisé dans les résistances électriques, susceptible d'être rapidement porté à incandescence, c'est-à-dire à une température comprise entre 700 et 1000°C environ, et plus particulièrement 800 à 900°C, de préférence sous l'action d'un courant électrique. Le réglage de la température peut être ajusté en fonction des conditions d'utilisation et des résultats recherchés.

L'une au moins des attaches du fil ou de la lame métallique est flexible pour assurer une tension constante malgré les variations de longueur dues à l'échauffement. Ce résultat peut être obtenu simplement en réalisant l'une au moins des attaches sous forme d'une languette métallique fixée au support par une extrémité, dont la flexibilité et l'élasticité assurent la tension du fil ou de la lame.

L'appareil conforme à la présente invention comporte un fil métallique susceptible d'être porté à incandescence, de longueur comprise entre 3 et 20 cm environ, monté sur un support servant de poignée, et maintenu à chacune de ses extrémités par une broche s'engageant dans une douille femelle, dont l'une est fixe et solidaire du support de l'appareil tandis que l'autre est montée sur une tige coulissante parallèle au fil, soumise à l'action d'un ressort qui tend à l'écarter de la douille fixe, et assure ainsi la tension du fil.

L'ensemble constitué par le fil et les deux broches fixées à chacune de ses extrémités peut ainsi être facilement mis en place sur l'appareil, en engageant la broche dans la douille montée sur la tige coulissante, en repoussant l'ensemble broche-douille contre l'action du ressort jusqu'à ce que la deuxième broche soit face à l'autre douille (fixe) dans laquelle on peut alors l'engager. L'enlèvement du fil de l'appareil ne présente aucune difficulté.

La broche et la douille sont réalisées en un matériau électriquement conducteur, et, suivant une forme préférentielle de réalisation, la douille fixe est vissée dans le support et la douille mobile est fixée dans la tête de la tige mobile.

Plus particulièrement, la tige coulissante est guidée par un fût solidaire du support, disposé parallèlement au fil métallique, et comporte une tête formant un épaulement dans lequel est vissée la douille recevant la broche fixée à l'une des extrémités du fil, le ressort étant comprimé entre le fût de guidage et la tête de la tige. Ce ressort prend appui sur le fût de guidage et tend à repousser la tige dont le débattement peut être limité par une butée formée dans le support.

La tige est réalisée en un matériau électriquement conducteur, par exemple en laiton, et est connectée à un fil d'alimentation électrique, le

passage du courant s'effectuant à travers la tige, les douilles, les broches, et le fil métalliqúe, qui est porté à incandescence.

Le support peut être réalisé en tout matériau électriquement isolant et offrant de préférence une bonne résistance à la chaleur. Il peut par exemple être réalisé par moulage en matière plastique.

Suivant une forme avantageuse de réalisation de l'invention, l'appareil comporte également un peigne, fixé au support, parallèlement au fil ou à la lame métallique, qui présente l'avantage d'assurer une double fonction de démêlage et guidage des cheveux d'une part, et de protection du fil ou de la lame métallique porté à température élevée d'autre part. Ce peigne est de préférence en métal ou alliage métallique mais peut être également en matière plastique résistant à la chaleur dégagée par la lame ou le fil chauffé. Il est disposé à une distance du fil ou de la comprise entre 0,2 et 1 cm environ, et de préférence entre 0,4 et 0,6 cm. Il peut le cas échéant être remplacé par un autre accessoire usuel de coiffure.

Accessoirement, ce peigne peut être fixé sur le support, de part et d'autre du fil métallique, par exemple au moyen de vis coopérant avec des trous taraudés prévus à cet effet dans le support, par clippage, ou par vis autotaraudeuse dans le cas d'un support en matière plastique, ou tout autre moyen approprié. On peut ainsi fixer un seul peigne d'un côté du fil métallique, ou deux peignes, de part et d'autre, selon le choix de l'utilisateur. Lorsque deux peignes sont fixés sur le support, ces deux peignes ne sont pas nécessairement de mêmes dimensions. Le peigne n'est toutefois pas indispensable au fonctionnement efficace de l'appareil.

Le support du fil ou de la lame métallique est prolongé par un manche formé de manière à être aisément tenu en main par l'utilisateur. Ce manche peut éventuellement être amovible ou orientable dans diverses positions pour faciliter l'utilisation de l'appareil.

Le fil ou la lame métallique est chauffé électriquement soit à partir d'une alimentation en courant alternatif par l'intermédiaire d'un transformateur et d'un régulateur de tension, soit à partir d'une source de courant continu telle qu'une batterie d'accumulateurs ou des piles électriques. A titre d'exemple, dans le cas d'une lame en alliage de 8 cm de longueur, 1 mm de largeur et 0,15 mm d'épaisseur, l'intensité du courant est d'environ 7A et la tension d'environ 6V.

Les caractéristiques et avantages de l'invention apparaîtront plus en détail de la description ci-après, relative à un mode préférentiel et non limitatif de réalisation, en référence aux dessins annexés, qui représentent:

Figure 1: une vue de face avec coupe partielle d'une variante du dispositif de l'invention.

Figure 2: une coupe suivant II–II sur la figure 1.

Figure 3: une demi-coupe suivant III–III sur la figure 1.

Figure 4: une coupe éclatée suivant IV–IV sur la figure 1.

Figure 5: une vue suivant la flèche F sur la figure 1 (peignes en éclatement).

L'appareil pour la coupe et le soin des cheveux par brûlage conforme à la présente invention, représenté sur la figure 1, comporte un support (1) se prolongeant par une poignée, deux douilles (12) et (12') recevant chacune une broche (13) et (13'), respectivement, et un fil (4) en métal conducteur monté sur chaque broche (13) et (13') sur lesquelles il est bloqué au moyen des vis (15) et (15').

Comme le montre la figure 4, la douille (12) est fixée dans le support par vissage dans la pièce intermédiaire (16) solidarisée au support (1). Le support, constitué de deux demi-coques fabriquées par moulage dans un matériau plastique approprié, se prolonge par le manche (7) disposé angulairement de manière à faciliter la préhension à la main en favorisant l'efficacité du mouvement de l'appareil permettant à l'utilisateur de couper les cheveux.

Le fil d'alimentation électrique (8) pénètre au niveau de l'extrémité du manche (7) et se raccorde au fil (4) par l'intermédiaire de la tige (20), sa tête (19), la douille (12') et la broche correspondante (13') d'une part, et de la pièce intermédiaire (16), la douille (12) et la broche correspondante (13) d'autre part.

La douille (12') est fixée par vissage dans la tête (19) d'une tige (20) coulissant dans le fût de guidage (21). Un ressort (22) comprimé entre la tête (19) de la tige (20) et le fût (21) tend à repousser la tige et l'ensemble douille-broche qui s'y trouve fixé, assurant ainsi la tension du fil (4).

Une butée (23) pratiquée dans le support permet de limiter le débattement de la tige coulissante (20), et évite tout risque de débordement de la tige (20) en cas de rupture accidentelle du fil métallique (4), assurant ainsi une sécurité supplémentaire.

Le support est constitué par moulage de deux demi-coques assemblées par vissage au moyen des trois vis (24). Il comporte en outre deux trous (25) permettant la fixation éventuelle de deux peignes (26) et (27) par vissage.

L'un des peignes peut être remplacé notamment par un accessoire en forme de plaque recourbée en «L» autour du fil (4) et comportant une échancrure destinée à guider une mèche de cheveux pour la couper en un point de la lame incandescente, en la parcourant dans sa longueur, à la manière des lames d'une paire de ciseaux.

Le fil d'alimentation (8) peut être raccordé au secteur (courant alternatif) par l'intermédiaire d'un transformateur et d'un régulateur de tension, ou à un bloc d'alimentation par accumulateurs ou piles électriques.

Revendications

1. Appareil pour la coupe et les soins des cheveux par brûlage comportant un fil ou une lame

métallique (4) susceptible d'être porté à incandescence, de longueur comprise entre 3 et 20 cm environ, maintenu à chacune des ses extrémités par deux attaches solidaires d'un support (1), dont l'une au moins est flexible et assure une tension sensiblement constante du fil ou de la lame quelle que soit sa température, caractérisé en ce que les attaches sont constituées par une broche (13, 13') s'engageant dans une douille femelle dont l'une (12) est fixe et solidaire du support (1), tandis que l'autre (12') est montée sur une tige coulissante (20) guidée par un fût (21) parallèlement au fil (4), soumise à l'action d'un ressort (22) qui tend à l'écarter de la douille fixe (12) et assure ainsi la tension du fil.

2. Appareil selon la revendication 1, caractérisé en ce que la tige coulissante guidée par un fût (21) solidaire du support et paralléle au fil (4), comporte une tête (19) dans laquelle est vissée la douille (12') recevant la broche fixée à l'une des extrémités du fil (4), le ressort (22) étant comprimé entre le fût de guidage (21) et la tête (19) de la tige (20).

3. Appareil selon la revendication 1, caractérisé en ce que le support est parallèle au fil ou à la lame métallique, à une distance de celui-ci comprise entre 0,5 et 4 cm environ, et est monté sur un manche.

4. Appareil selon la revendication 1, caractérisé en ce qu'il comporte une lame métallique de largeur égale à environ 1 mm et d'épaisseur comprise entre 0,1 et 0,3 mm.

5. Appareil selon l'une quelconque des revendications précédentes, caractérisé en ce qu'un ou deux peignes amovibles (26, 27) peuvent être fixés sur le support (1), de part et d'autre du fil métallique (4).

6. Appareil selon l'un quelconque des revendications précédentes, caractérisé en ce que le fil ou la lame métallique est chauffé par une alimentation électrique.

Patentansprüche

1. Gerät zum Stützen und Pflegen von Haar durch Brennen, mit einem Draht oder einem dünnen Metallstreifen (4), der bis zum Glühen gebracht werden kann, eine Länge von ungefähr 3 bis 20 cm aufweist und an seinen Enden durch zwei an einem Träger (1) angebrachte Halterungen gehalten ist, von denen wenigstens eine flexibel ist und eine im wesentlichen konstante Spannung an dem Draht oder dem dünnen Streifen sicherstellt, wie auch immer dessen Temperatur ist, dadurch gekennzeichnet, dass die Halterungen von einem Dorn (13, 13') gebildet sind, der in eine weibliche Hülse eingreift, von denen eine (12) fest und an der Stütze (1) befestigt ist, während die andere (12') an einer verschiebbaren Stange (20) angebracht ist, die von einem zu dem Draht (4) parallelen Schaft (21) geführt und der Kraft einer Feder (22) ausgesetzt ist, die bestrebt ist, jene von der festen Hülse (12) zu entfernen und somit die Drahtspannung sicherstellt.

2. Gerät nach Anspruch 1, dadurch gekennzeichnet, dass die verschiebbare Stange, die von einem an der Stütze befestigten Schaft (21) und parallel zu dem Draht (4) geführt ist, einen Kopf (19) aufweist, in den die Hülse (12') geschraubt ist, welche den an einem Ende des Drahtes (4) befestigten Dorn aufnimmt, und dass die Feder (22) zwischen dem Führungsschaft (21) und dem Kopf (19) der Stange (20) zusammengedrückt ist.

3. Gerät nach Anspruch 1, dadurch gekennzeichnet, dass die Stütze parallel zu dem Draht oder dem dünnen Metallstreifen mit einem Abstand von diesen zwischen ungefähr 0,5 und 4 cm verläuft und an einem Handgriff befestigt ist.

4. Gerät nach Anspruch 1, dadurch gekennzeichnet, dass es einen dünnen Metallstreifen mit einer Breite von ungefähr 1 mm und einer Dicke zwischen 0,1 und 0,3 mm aufweist.

5. Gerät nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass ein oder zwei abnehmbare Kämme (26, 27) an dem Träger (1) beidseitig des Metalldrahts (4) befestigt werden können.

6. Gerät nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass der Draht oder der dünne Metallstreifen durch eine elektrische Stromversorgung heizbar ist.

Claims

1. Appliance for hair cutting and hair care by singeing, comprising a metal wire or strip (4) capable of being made incandescent, of a length between approximately 3 and 20 cm, retained at each of its ends by two fasteners fixed to a support (1), at least one of which is flexible and ensures a substantially constant tension of the wire or strip, whatever its temperature, characterized in that the fasteners consist of a pin (13, 13') engaging into a female socket, one (12) of which is stationary and fixed to the support (1), whilst the other (12') is mounted on a sliding rod (20) guided by a sleeve (21), parallel to the wire (4) and subjected to the action of a spring (22) which tends to move it away from the stationary socket (12) thus ensuring the tension of the wire.

2. Appliance as claimed in claim 1, characterized in that the sliding rod guided by a sleeve (21) fixed to the support and parallel to the wire (4), has a head (19) in which is screwed the socket (12') which receives the pin secured to one of the ends of the wire (4), the spring (22) being compressed between the guide sleeve (21) and the head (19) of the rod (20).

3. Appliance as claimed in claim 1, characterized in that the support is parallel to the wire or to the metal strip, at a distance from the latter of between approximately 0.5 and 4 cm, and is fitted on a handle.

4. Appliance as claimed in claim 1, characterized in that it comprises a metal strip of a width equal to approximately 1 mm and a thickness of between 0.1 and 0.3 mm.

5. Appliance as claimed in any one of the pre-

ceding claims, characterized in that one or two removable combs (26, 27) can be fastened to the support (1) on either side of the metal wire (4).

6. Appliance as claimed in any one of the preceding claims, characterized in that the metal wire or strip is heated by an electrical supply.

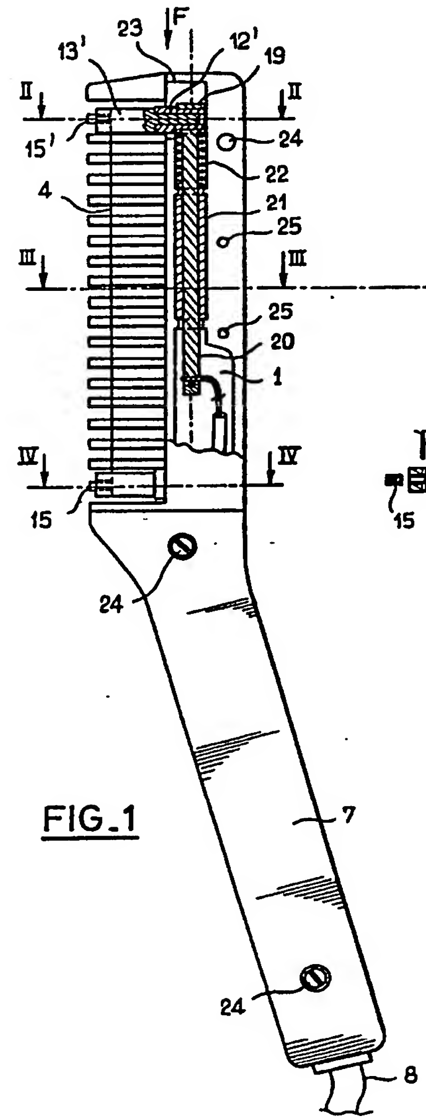


FIG_1

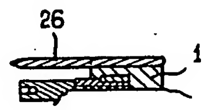


FIG_2

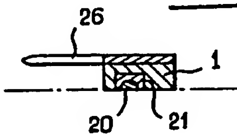


FIG_3

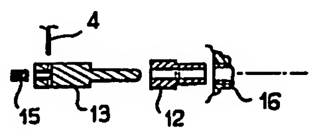


FIG_4

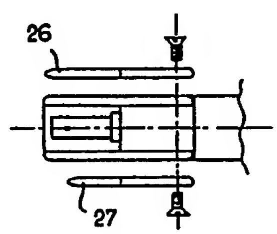


FIG_5

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 01-288291
(43)Date of publication of application : 20.11.1989

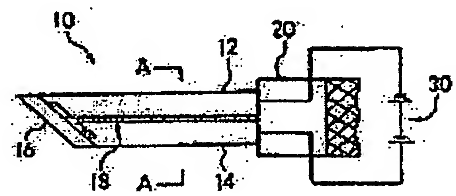
(51)Int.Cl. B26B 3/00
A61B 17/32
A61B 17/38
B26B 9/00

(21)Application number : 63-115997
(22)Date of filing : 14.05.1988

(71)Applicant : INOUE JAPAX RES INC
(72)Inventor : INOUE KIYOSHI

(54) CERAMIC KNIFE

(57)Abstract:
PURPOSE: To exhibit characteristics according to various kinds of objects and cut parts by forming the back part of a knife of a first electrode plate, forming the web part of a second electrode plate, forming a head part of conductive ceramics, and arranging an insulator in a gap so as to cause a current to flow from the first electrode plate through the ceramics to the second electrode plate.
CONSTITUTION: The back part of a ceramic knife 10 is formed of a first electrode plate 12, the web part of the knife is formed of a second electrode plate 14, and the tip part of the knife is formed of conductive ceramics 16 to be generated heat by the current. An insulator 18 is arranged in the gap so as to cause the current to flow from the first electrode plate 12 through the ceramics 16 to the second electrode plate 14, and the whole shape of the knife is composed. When the current from a power source 30 is made to flow through a handle part 20 of the knife inside between the first electrode plate 12 and second electrode plate 14, the ceramics 16 generates heat, the object is melted by heating, and a cutting work is exhibited. As the conductive ceramics, for example, the ceramics, in which TiN, TiC, SiC, B4C, TiB2, etc., are added to ZrO2, are used.



LEGAL STATUS
[Date of request for examination]
[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

DERWENT-ACC-NO: **1990-004590**

DERWENT-WEEK: 199001

TITLE: Ceramic knife used in surgical operations - comprises back part made of 1st electrode plate, body part made of 2nd electrode plate and tip made of conductive ceramic material, etc.

PATENT-ASSIGNEE: INOUE JAPAX RES INC[INOZ]

PRIORITY-DATA: 1988JP-0115997 (May 14, 1988)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
JP 01288291 A	November 20, 1989	N/A	003	N/A

APPLICATION-DATA:

PUB-NO	APPL-DESCRIPTOR	APPL-NO	APPL-DATE
JP 01288291A	N/A	1988JP-0115997	May 14, 1988

INT-CL (IPC): A61B017/32, B26B003/00 , B26B009/00

ABSTRACTED-PUB-NO: JP 01288291A

BASIC-ABSTRACT:

Ceramic knife comprises a back part made of a 1st electrode plate, a body part made of a 2nd electrode plate, a tip made of a conductive ceramic material, e.g., ZrO_2-TiB_2 (30 wt.%) mixt., etc., and an insulator set

in the aperture
between the 1st and 2nd electrodes. A pulsating electric current is applied
between the 1st and 2nd electrodes to allow the electric current to flow from
the 1st electrode to the 2nd electrode, to heat up the conductive ceramic
material.

USE/ADVANTAGE - Used in a surgical operation, etc. It has a simple structure
and has good cutting function in a varying pattern.

CHOSEN-DRAWING: Dwg.0/3

TITLE-TERMS: CERAMIC KNIFE SURGICAL OPERATE COMPRISE BACK PART MADE ELECTRODE
PLATE BODY PART MADE ELECTRODE PLATE TIP MADE CONDUCTING CERAMIC
MATERIAL

DERWENT-CLASS: L02 P31 P62

CPI-CODES: L02-G07; L03-H04A;

SECONDARY-ACC-NO:
CPI Secondary Accession Numbers: C1990-002015
Non-CPI Secondary Accession Numbers: N1990-003484

⑲日本国特許庁（JP）　⑪特許出願公開

⑫公開特許公報（A）　平1－288291

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B 26 B 3/00		Z－6864－3C	
A 61 B 17/32	310	7242－4C	
17/38	310	7242－4C	
B 26 B 9/00		Z－6864－3C	審査請求　未請求　請求項の数　2　（全3頁）

㊹発明の名称　セラミックナイフ

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㉒出　　願　昭63(1988)5月14日

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明　細　書

1.（発明の名称）

セラミックナイフ

2.（特許請求の範囲）

1.　ナイフの背部を第1の電極板で形成し、ナイフの腹部を第2の電極板で形成し、ナイフの先端部を電流により発熱する導電性セラミックスで形成し、第1の電極板から前記セラミックスを介して第2の電極板へと電流が流れるように間隙に絶縁体を配置してナイフの全体形状を構成し、第1の電極板と第2の電極板との間に電流を流して前記セラミックスを発熱させるようにしたことを特徴とするセラミックナイフ。

2.　前記電流をパルス状に加えてナイフに振動を与えるようにした請求項1記載のナイフ。

3.（発明の詳細な説明）

（産業上の利用分野）

本発明は、各種の対象物を切断することが可能なセラミックナイフに関し、特に外科手術に利用するのに適したセラミックナイフに関する。

（従来の技術）

外科手術においては、高周波メスやレーザメス等が広く使われているが、これらはいずれも装置が複雑で取り扱いが難しく、熟練するまでに長時間を要し、コストが高いという欠点がある。

実開昭61－29716号公報には、ダイヤモンド、サファイア、ルビー等の人造石からなるマイクロサージャリー用メスが開示されているが、このような特性が一定の刃では、切断する対象物に合わせて多数のナイフを準備し、次々にナイフを交換しなければならず、手術時間が延びてしまうおそれがある。

（発明が解決しようとする問題点）

本発明の目的は、簡便な構造でありながらその切断性能を変化させることができ、各種の対象物や切断部位に応じた特性を発揮することが可能なセラミックナイフを提供することにある。

（問題点を解決するための手段とその作用）

本発明の前述した目的は、ナイフの背部を第1の電極板で形成し、ナイフの腹部を第2の電極板

で形成し、ナイフの先端部を電流により発熱する導電性セラミックスで形成し、第1の電極板から前記セラミックスを介して第2の電極板へと電流が流れるように間隙に絶縁体を配置してナイフの全体形状を構成し、第1の電極板と第2の電極板との間に電流を流して前記セラミックスを発熱させるようにしたセラミックナイフによって達成される。

セラミックスが抵抗発熱体として利用できることは周知であり、その物質として、ZrO_2や、HfB_2、MoB_2、CrB_2、ZrB_2、TaBなどのホウ化物その他が知られている。本発明では、例えば ZrO_2に TiN、TiC、SiC、B_4C、TiB_2などを混入して任意の抵抗値の発熱体を作ることができる。

かかる構成に基づき、本発明のナイフによれば、電極板の間に電流を流すことによりセラミックスが発熱して対象物を溶融させ、能率的な切断を行なうことができる。電流の値を変化させることによりナイフの特性が変化するから、対象物が変っても同じナイフを使い続けることができて、能率が向上し安全性が高められる。

本発明はその好適な実施態様として、電極間にパルス状の電流を加えたり、その他の振動発生機構を取付けることにより、ナイフを振動させることができ、これによりさらに効率的な切断作業を行なうことができるようになる。

また、刃の表面をPVD(物理気相蒸着法)やCVD(化学蒸着法)、あるいは硬化マイクロ溶接によって硬化処理し、耐摩耗性を高めることができる。

本発明の他の特徴及び利点は、添付図面の実施例を参照した以下の記載により明らかとなろう。

(実施例)

第1図、第2図は、本発明の第1実施例によるセラミックナイフ10を表わしており、ナイフの背部が第1の電極板12で形成され、ナイフの腹部が第2の電極板14で形成され、ナイフの先端部が電流により発熱する導電性セラミックス16で形成され、第1の電極板12からセラミックス16を介して第2の電極板14へと電流が流れるように間隙に絶縁体18が配置されてナイフの全体形状が構成されている。ナイフの握り部分20内を通って電源30からの電流が第1の電極板12と第2の電極板14との間に流れると、セラミックス16が発熱し、加熱により対象物を溶融して切断作用を発揮するようになっている。

導電性セラミックスとして、ZrO_2に30重量%の TiB_2を加えたセラミックスを使用した。このセラミックスは温度が上昇すると抵抗値も増大するようになっており、ほぼ一定の温度が保てるという特性を有している。

第3図は、本発明の第2実施例によるセラミックナイフ40を表わしており、ナイフの背部が第1の電極板42で形成され、ナイフの腹部の後側部分が第2の電極板44で形成され、ナイフの先端部から腹部の前側部分にかけて電流により発熱する導電性セラミックス46が配置され、第1の電極板42からセラミックス46を介して第2の電極板44へと電流が流れるように間隙に絶縁体48が配置されてナイフの全体形状が構成されている。

セラミックスの刃46の前側部分にはPVD処理による硬化膜50が形成されて、硬度が高くなっている。

この実施例ではさらに、電源60とパルス発信器62と半導体素子64とを含む半導体パルス電源装置70が配置されており、ナイフの握り部分52内を通ってパルス電源60からのパルス状電流が第1の電極板42と第2の電極板44との間に流れると、セラミックス46が発熱すると同時に、電極及びセラミックスを含んだナイフ全体が振動を発生し、加熱と振動の相乗効果によって対象物を溶融排除して切断作用を発揮するようになっている。

ナイフの形状及び材質は、対象物に応じていろいろと選定することができ、セラミックスの発熱温度や電流値など、各種のセンサーを用いて切断操作をコンピュータ制御することが望ましい。

(発明の効果)

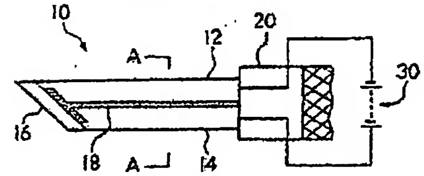
以上詳細に説明した如く、本発明のセラミックナイフによれば、非常に簡便な構造でありながらその切断性能を変化させることができ、各種の対象物や切断部位に応じた特性を発揮することが可能なセラミックナイフが提供されることになり、その技術的効果には極めて顕著なものがある。

4.〔図面の簡単な説明〕

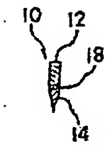
第1図は本発明の第1実施例によるセラミックナイフの一部を破断した概略正面図、第2図は第1図の線A－Aに沿う断面図、第3図は第2実施例によるセラミックナイフの一部を破断した概略正面図である。

10、40・・・ナイフ
12、14；42、44・・・電極
16、46・・・セラミックス
18、48・・・絶縁体
30、60・・・電源
70・・・パルス電源装置

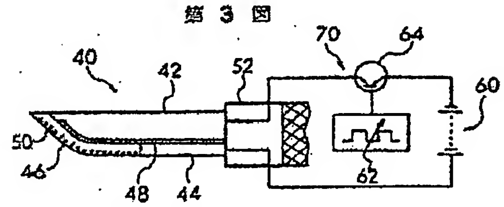
第1図



第2図



第3図



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FR-A- 1 142 270
GB-A- 918 930
US-A- 3 475 368
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Description

The present invention is concerned with an improved high speed process of making polyamide filaments wherein an additive having a molecular weight of less than 400 and selected from the group consisting of water, alcohols, and organic acids is added to a polymer.

The present invention is classified in the area of synthetic resins, more particularly in the area of processes of preparing a desired or intentional composition of at least one nonreactant material and at least one solid polymer or specified intermediate condensation product, or product thereof, wherein the nonreactant material is added to the solid polymer. Within this main area, art related to the present invention may be found among organic nonreactant materials in which a carbon atom is singly bonded to an oxygen atom and wherein there is either: (a) only a single C- OH group and at least six carbon atoms or (b) at least two-OH groups. Also within this main area, related art may be found within the area in which the polymer is derived from ethylenic, nitrogen-containing reactants only wherein water is the nonreactant material.

Applicant has located several prior art U.S. patents which are related to the present invention, including U.S. 3,182,100; U.S. 3,093,445; U.S. 2,615,002; U.S. 2,943,350; U.S. 4,049,766; U.S. 3,549,651; and U.S. 3,388,029. Applicant has also located several journal articles related to the nonobviousness of the present invention, including:

(a) V.S. Shirshin, V. Vais, et al., Effect of Polycaproamide Transport and Storage Conditions on Change in its Qualitative Indices, copyright 1984 Plenum Publishing Corporation, pp. 398-401.

(b) M.I. Kohan, Nylon Plastics, J. Wiley & Sons, copyright 1973, pp. 210 and 427-428.

The U.S. patents referred to above pertain to a material which is either residual or added to the polymer. However, none of these patents refer to high speed processes, i.e., processes in which the yarn is travelling at a speed which is greater than 3200 meters per minute. As is shown in the examples below, the effects of melt additives are opposite when comparing high and low speed processes.

The articles referred to above (a and b) teach that in high speed processes, the nylon polymer should contain as little water as possible. This is contrary to the present invention. The advent of high speed spinning technology has been relatively recent, and teachings related to production speeds versus polymer content are very rare in the high speed area.

The present invention is concerned with an improved high speed process for the production of polyamide filaments, especially filaments of textile quality. The process is carried out by adding one or more members of a selected group of additives consisting of water, alcohols, and organic acids to the polyamide in order to improve package build, yarn quality, and yarn processing conditions: For example, it has been found that less package deformation occurs under the instant process. Furthermore, low elongation and increased tenacity are possible, among other product improvements, by utilizing the instant process. Finally, higher yarn production speeds are possible utilizing the instant process.

The improved process comprises the steps of:

a) Mixing the additive into the polyamide in order to form a mix; and

(b) Extruding the mix to form filaments; and

(c) Quenching the filaments; and

(d) Taking up the filaments at high speed.

In the improved process, the additive must be thoroughly mixed so that a homogeneous mix is formed. It has been conceived that the additive may be added in any amount so long as a resulting molten polymer mix has a relative viscosity between 2.0 and 3.0. Since polyamides are hygroscopic and water is generally present to some degree prior to spinning, water is only considered to be an "additive" if it is present in an amount greater than 0.15% by weight.

It is an object of the present invention to enable an improved high speed melt spinning process for polyamides.

It is a further object of the present invention to enable higher speeds for the melt spinning of polyamide textile filaments.

It is a further object of the present invention to improve package build in the high speed melt spinning of polyamide textile filaments.

It is a further object of the present invention to prevent tube crushing without heat relaxation of the yarn in a high speed polyamide melt spinning process.

It is a further object of the present invention to utilize additives in order to improve the high speed melt spinning of polyamides.

It is a further object of the present invention to enable one to simultaneously lower the elongation and increase the modules of polyamide textile filaments.

It is a further object of the present invention to enable improved washfastness and dye uniformity of

polyamide filaments made with high speed melt spinning processes.

It is a further object of the present invention to utilize additives in a high speed spin-draw-wind process for the manufacture of polyamide filaments.

It is a further object of the present invention to achieve acceptable tensile properties at low draw ratios.

It is a further object of the present invention to lower the relative viscosity of the melt by adding an additive, followed by spinning a yarn with lower elongation than would have occurred had the additive not been added, all other conditions remaining the same.

It is a further object of the present invention to enable one to increase the take-up speed (without experiencing tube crushing) by at least 1200 meters per minute with respect to the speed at which tube crushing begins to occur without additives.

It is a further object of the present invention to enable one to obtain a higher modulus and lower elongation product at processing speeds slower than one would obtain in a process identical except without additives.

The present process is concerned with adding water, alcohols, and/or organic acids to polyamides in order to improve the resulting textile product and/or processing in a high speed filament production operation. It has been unexpectedly found that in high speed polyamide filament production, water, alcohols, and organic acids have a beneficial effect on the melt if they are added in limited amounts and for limited times so that the resulting polymer mix has a relative viscosity (as measured in 96% sulphuric acid) between 2.0 and 3.0. Classical theory (e.g. U.S. patent 3,475,368) states that addition of plasticizers to a polymer will result in an increase in the elongation and a decrease in both the modulus and breaking strength. However, it has been unexpectedly discovered that the opposite occurs in high speed melt-spinning processes for polyamides, i.e. the addition of one or more of the additives recited above to the polymer prior to a high speed extrusion process will improve the tensile properties, i.e. raise the modulus and lower the elongation. In high speed spin draw processes for the production of polyamide textile filaments, there has been a problem with tube crushing as the yarn puts great force on the tube, causing it to collapse on the winder chuck, making it impossible to remove the tube from the winder without destroying the yarn package thereon. The use of additives has been found to relieve the tube crushing problem by reducing the build up of the yarn stresses which cause tube crushing.

It has been demonstrated that the use of the additives of the present invention will allow one to obtain beneficial extensions of processing speeds in the production of polyamide filaments. For example, since the use of additives lowers the relative viscosity while simultaneously creating package relaxation (as shown in Figures 4-8), the use of additives can allow one to increase the take up speed by at least 1200 meters per minute (without tube crushing) with respect to the speed at which tube crushing begins to occur without additives. Furthermore, since the use of additives lowers the elongation and elevates the modulus of the product, the use of additives will allow one to obtain a product having similar characteristics at lower processing speeds.

In a preferred process of the present invention, a polycaprolactam polymer chip has an additive thoroughly mixed therewith followed by melting (in a screw extruder) and extrusion through a spinnerette, forming a plurality of molten polycaprolactam filaments. The molten polycaprolactam filaments are then quenched. After quenching the filaments are coalesced and simultaneously have finish applied thereto by a finish metering device. Generally, the coalesced filaments are then drawn (between 1.02x and 1.8x), followed by air jet entanglement. However, it is not absolutely necessary to draw the filaments. The filaments are then wound.

The process of the present invention is preferably carried out in a high speed spin-draw-wind process, wherein the fastest travelling surface is moving at a speed of at least 3200 meters per minute. Generally, the fastest travelling surface is the downstream draw godet, as the yarn is drawn between the first and second godet, and is then relaxed between the second godet and the winder.

In this preferred process, the polymer mix is extruded through a spinnerette, quenched, has finish applied thereto, is drawn by partial wrap on two godets, and is then wound on a bobbin. Most preferably, the yarn is interlaced after drawing.

Figure 1 illustrates the process of the present invention as it appears downstream of, and including, the chip hopper. The chip hopper (1) is supplied with chip (2). The hopper (1) in turn supplies the extruder (3) throat with chip (2). An additive pump (4) is shown simultaneously supplying the extruder throat with a liquid additive, this process being carried out by simply dripping the liquid onto the chip stream which is entering the extruder (3). Once the chip exits the extruder as a molten stream (5), the stream is pumped through a conduit (6) which contains a plurality of static mixers (7). Once through the static mixers (7), the mix stream enters the spinnerette (8) and is extruded into a plurality of molten streams (9) which are solidified in a quench zone and are then coalesced and simulataneously have finish applied by a finish applicator (10).

The coalesced filaments (11) then travel downward through an interfloor tube, schematically indicated by the "break" (12). The yarn next travels around a first (upstream) powered godet (13) and then around a second (downstream) powered godet (14), following which the yarn (11) is interlaced by an interlacer (15). Lastly, the yarn is wound into a bobbin (16).

The yarn may be drawn by being passed over two or more godets which travel at different surface speeds, i.e., the surface speed of the downstream godet being at least two percent higher than the surface speed of the upstream godet.

Table I, containing Examples 1 through 86, pertains to processes carried out using the preferred apparatus as described above. As can be seen from these examples, the relative viscosity of the polymer dropped with increasing amounts of additive, but unexpectedly the elongation decreased. These examples show that the improved process is operable for different polyamide polymers. These polymers, coded as B300, B216, etc. are described in detail in Table II. The additives utilized in Table I have been specifically chosen in order to illustrate that the process is operable for a variety of additives, including water, alcohols, and organic acids. The data presented in Table I illustrates the process of the present invention when the additive is water, a primary alcohol, a secondary alcohol, a diol, a tetraol, an aliphatic acid, or an aromatic acid. Furthermore, these examples indicate that the invention is operable for a variety of winding speeds, draw ratios, and filament types and sizes. Note that in every instance the elongation with additive is lower than its corresponding control example, and that the modulus with additive is greater than its corresponding control example.

It is believed that at least four characteristics are always changed in the same direction (with respect to a control example) through the use of these additives. These characteristics are: elongation, modulus, washfastness, and package relaxation. Elongation decreases with additives, modulus increases with additives, washfastness increases with additives, and package relaxation increases with additives.

Table III illustrates the improved washfastness for several examples given in Table I. In Table III a control example was run by spinning a B300 chip without additives, the resulting filaments being drawn at a draw ration of 1.05, the filaments then being wound at a speed of 4750 meters per minute, just as in Examples 1, 5 and 10. The product was knitted into a hoseleg, which was then cut into two pieces each piece of which was then dyed. One piece was dyed in Kiton fast Blue (C.I. Acid Blue 45) dye, the other in Celanthrene fast Blue CR (C.I. Disperse Blue 7) dye. Each piece was then washed five times in a conventional washing machine. The hoselegs had Δ E measurements (CIELAB) taken before and after washing. A Δ E value was determined for each of the pieces. The same process was undertaken for several examples listed above. Table III gives the results of these tests for washfastness. The Δ E values have been normalized with respect to the control sample in order to make comparisons easy. In samples 31 through 34, an Ortolon Blue G (C.I. Acid Blue 151) dye was used in addition to Kiton and Celanthrene. As can be seen from the data in Table III, the washfastness of the fabrics made using yarns containing additives was always superior to the washfastness of the fabrics made using yarns which were made without additives.

Examples 1 through 86 were carried out using the preferrred high speed spin-draw-wind process described above. These examples illustrate a variety of conditions with respect to spinning speeds, draw ratio, additive amount, additive type, polyamide polymer characteristics (see Table II), and yarn type. For each set of conditions, the resulting: (a) relative viscosity (RV) of the melt mix; (b) percent elongation of the product; and (c) breaking load at 10% elongation (L-10) were given. The examples are shown in "sets" (i.e. Examples 1-4, 5-9, 10-20, etc.), in which a given polymer type was spun with a given additive, the filaments then being drawn at a fixed draw ratio, and wound at a fixed speed, while the amount of additive was varied. Control examples (using no additive, i.e. pure polymer) were run for each set of conditions, the control runs being the first run of each set shown in Examples 1 - 86. In the "Filament Type" column, the first number represents the total denier and the second number represents the number of filaments, while the R represents a round cross-section and the T represents a trilobal cross-section.

The most significant result from Examples 1 - 86 is the unexpected effect that increasing the amount of additive had on the product elongation: As RV dropped due to increasing amount of additive added, percent elongation surprisingly also dropped. To one of skill in the art, a drop in RV would normally be expected to create a gain in the percent elongation of the product, all other factors remaining the same. In fact, RV and percent elongation are inversely proportional in low speed processes, as is discussed below. In Examples 1 - 86, it can be seen that at high speeds, the use of an additive consistently lowered both the RV of the polymer mix and the resulting elongation of the product, as compared with the control run. This result was found for all five polyamide polymer chip types investigated, and all seven additives investigated. Furthermore, this effect was substantiated at draw ratios of 1.00, 1.05, 1.07, 1.13, 1.14, 1.20, 1.30, and 1.45, and at winder speeds of 4,000, 4,300, 4,750, 5,000, 5,250, and 5,660 meters per minute. In addition, Examples 1 - 86 show that the L-10 is almost always higher through use of an additive. In Examples 1 - 86,

it was not always found that the addition of "more additive" caused a FURTHER decrease in elongation, and/or FURTHER increased L-10, but it was found that the addition of "more additive" always created a further lowering of the RV. However, the addition of "more additive" always resulted in an RV lower than the control, a percent elongation lower than the control, and an L-10 higher than the control.

The unusual, unexpected result found in Examples 1 - 86 is the fact that the use of a low viscosity, low molecular weight additive lowered the elongation of the resulting product. It would normally be expected that the use of such an additive would raise the elongation of the product. In fact, this second situation turns out to be true, specifically in the classical 2-stage production process, as shown in Table V. Thus, the advantage of the additives described herein is limited to high production speeds, as recited in the claims. It therefore becomes apparent that another unexpected element is found in the present invention: the combination of the additive together with the requirement of high speed process operation. Table V illustrates how product elongation rises with the use of an additive, compared with the identical process conditions without the use of additives.

For purposes of the present invention, the term "additive" is herein defined to include only substances having a molecular weight of less than 400, these substances having a melting point below the temperature at which melt spinnning is carried out. Furthermore, the additives must be within the group consisting of water, alcohols, and organic acids. Water is considered to be the most preferred additive. If water is the additive, the water must be present in the mix in an amount which is greater than 0.15% by weight. This is because the polyamide polymers spun at high speed in the prior art occasionally contain some moisture, often by accident, and this moisture is believed always to have been less than 0.15%, thus the scope of the present invention has been limited to specifically avoid overlap with this accidental prior art which was considererd undesirable heretofore.

It has been found that the mixing of the additive into the polymer must result in a uniform mix, or the product will not have sufficient uniformity of characteristics, i.e. yarn properties will vary undesirably, as well as yarn processability. In order to insure adequate mixing, 26 4x4 motionless, continuous Interfacial Surface Generator mixers were installed in the pipe leading from the extruder to the spinnerette, these ISG's being used in Examples 1 through 86. These mixers are described fully in U.S. 3,583,678, which is herein incorporated by reference. Mixers identical to those utilized in the Examples herein, can be obtained from Charles Ross & Son Co., 710-718 Old Willets Path, Hauppauge, Long Island, N.Y. 11787. Table IV illustrates the need to adequately mix the additive with the polymer. Without adequate blending of the polymer with the additive, yarn chemical properties will vary undesirably from threadline to threadline, as will yarn processability. Table IV shows that RV range, amino end group range, Kiton dye junction range, and warping defects vary considerably more, and to an undesirable degree, without mixing as opposed to with mixing using 26 static mixers.

The use of the additives of the present invention may provide a variety of benefits in addition to elongation and L-10. For example, package deformation may be decreased through use of additives. The yarn made in Example 58 was wound onto a bobbin for a period of two hours. The package could be readily removed from the chuck. This indicates that even at high draw ratios and relatively high winder speeds, the additive can allow one to produce a product which has very little internal stress when compared to an identical process without additive use. It is believed that if the process of Example 58 was carried out without additive, the bobbin would not have been removable from the chuck, all other conditions being the same.

Examples 62 through 69 demonstrate the effect of additive on reduction of internal package stress. During this series of Examples, the winder speed remainded constant while the speed of both godets (13 and 14) was reduced in order to maintain constant yarn tension between the second godet and the winder. In Example 69, in which 1.5% water was added, the godet speed could not be slowed enough to keep the yarn from falling off of the bobbin, as the yarn was actually expanding as it was being wound onto the bobbin. In fact, the godets were slowed until a 15-20 gram tension was applied to the yarn between the second godet and the winder (compared with 6 grams of yarn tension used in Examples 62-65), and still the yarn expanded off the bobbin.

Actual package deformation is created by yarn shrinkage on the bobbin. Shrinkage of yarn on the bobbin creates a "side bulge" deformation and a "concave top" deformation to the bobbin, and if shrinkage is large enough, tube crushing may also occur. Package deformation has been reduced through the use of additives. Figure 2 illustrates package "side bulge deformation" (d) while Figure 3 illustrates "concave top deformation" (d'). In reality, a deformed package contains both types of deformation simultaneously.

Figure 4 illustrates the effect of increasing the speed of the godets (13 and 14) on the amount of concave top deformation, this process being carried out without the use of an additive. As can be seen from the upward slope of the line of Figure 4, the amount of "concave top" package deformation increases

linearly between godet speeds of 4,000 and 5,000 meters per minute, if additives are not employed. Figure 5 illustrates the same situation, except that 0.75% water was added to the polymer immediately before the extruder, the additive then being mixed thoroughly with the polymer. Figure 5 indicates that the use of water effectively eliminated any INCREASE in the "concave top" package deformation between speeds of 4,000 and 5,000 meters per minute. The runs performed in Figures 4 and 5 utilized B300 polymer, a draw ratio of 1.00, and produced a 40 denier 12 filament product. Figure 6 illustrates how increasing the percent additive creates a decrease in the concave top deformation for the high speed process described herein.

Figure 7 illustrates the effect of godet speed on "side bulge" package deformation (d, as shown in Figure 2), this figure indicating that as the speed of the godets is increased from 4,000 to 5,000 meters per minute, the "side bulge" package deformation increases sharply from 3 millimeters to 7.5 millimeters. The process runs indicated by Figure 7 were performed without additives. Figure 8 illustrates the effect of additives on "side bulge" deformation. As additive (in this example, water) concentration increased, side bulge deformation decreased sharply. The process runs of Figure 7 utilized B300 chip, a draw ratio of 1.00, and produced a 4.444 tex (40 denier), 12 filament yarn. The process runs of Figure 8 utilized B216 chip, a draw ratio of 1.00, and produced a 4.444 tex (40 denier), 12 filament yarn, at the takeup speed of 5,000 meters per minute.

The particular winder used to build a package is also related to package deformation. When using either a Barmag SW46SSD/4 or a Reiter J7/H4 winder, at a constant winder setting (dependent upon the speed to give a constant helix angle), large packages of 4.444 tex (40 denier), 12 filament yarns were made and measured for changes in top curvature and side deformation of the yarn package in millimeters. It was found that without additives the concave top curvature and outward side deformation increased as the winder speed increased (tex[denier] remaining constant). However, with the addition of an additive the deformations decreased in proportion to the amount of additive. Also, unexpectedly, when 0.75% water was added to polyamide under the conditions illustrated in Figure 5, an increase in speed created no substantial increase in package deformation. This phenomenon is considered to be of great importance, as the use of the additives may make higher production speeds possible, without tube crushing or undesirable package deformation levels, without the addition of heat relaxation devices.

Another benefit from the use of the additives of the present invention is found in the dye uniformity of fabrics made from the yarn which was produced using additives. Fibre was produced by adding 0.5% H_2O to B216 chip. The filaments were produced by the process illustrated in Figure 1, on which apparatus the filaments were drawn 1.14x and wound up at 5000 meters per minute. The yarn produced was a 4.444 (40)-/12 dull yarn (i.e. the yarn contained titanium dioxide). The yarn was used to make single bar tricot fabric. The fabric was then dyed with an acid dye, a disperse dye, and a premetallized dye. The fabric was visually rated for dye uniformity on a scale of 1 to 7, where 1 represents the highest quality of dye uniformity i.e. no visible nonuniformities. All of the dyed samples rated at 2. Other fabrics were produced from yarns manufactured without additives but on the same apparatus. None of these other fabrics rated as highly as 2 for all three types of dyes used.

The use of additives as described herein has enabled large packages to be made consistently at high speed. For example, a B300 chip (RV=2.8) was used to produce 128 large packages of yarn. The polymer had 2% water added, with the resulting uniform mix being extruded into filaments. The process was carried out by the apparatus of Figure 1. The filaments were drawn 1.04x between the godets, and were then wound at 5100 meters per minute. The yarn produced was a 4.444 tex (40 denier), 12 filament bright, triangular cross-section yarn, having an elongation of 50%. Four six-hour doffs were made each day for each of 2 machines which were operated over a four day period, resulting in 128 packages of yarn, as each machine produced 4 packages simultaneously. The full package yield was over 96%, and the warping performance was under 0.2 defects per million end yards.

The use of the process of the present invention may also provide a method of making a very uniform product. For example, a B216 chip having 0.5% water mixed uniformly therewith was spun (by the apparatus of Figure 1) into a 4.444 (40)/12 yarn. The filaments were drawn 1.14x and wound at 5000 meters per minute. The yarn was then warpknitted, and exhibited only 0.27 defects per million end yards. The yarn had the following characteristics: % elongation of 50.0 ± 2.0; L-10 of 57.8± 1.8 grams; tex of 4.444±.019 (denier of 40.0±.18); breaking load of 169 ± 4.5 grams; entanglement level of 19.0 ± 2.0 nodes per meter; Kiton (acid dye C.I. 45) dye junction of ± .66: Celanthrene (C.I. Disperse Blue 7) dye Junction of ± .48. Table VI illustrates the uniformity of chemical properties for three trial process runs using additives. As can be seen on Table VI, all three runs produced yarn having a high degree of chemical uniformity. These samples were collected periodically throughout each of the three trials.

Table VII provides one explanation for many of the above-described advantages of the present invention. Table VII indicates that the use of additives enables a higher degree of polymer orientation. This

is verified by several different measurements which are directly related to the degree of polymer orientation (e.g. birefringence, sonic moduli, amorphous orientation, gamma crystal size, etc.).

Birefringence measurements were taken on conditioned round filaments which had been mounted in a Leitz Universal Research microscope, Model orthoplan (with a polarizer and rotating analyzer). Retardation was measured by a Berek tilting compensator.

Sonic Modulus measurements were taken on conditioned samples, using a Dynamic Modulus Tester model PPM-5R, manufactured by the H. M. Morgan Company, Inc. The slope from 5 curves were averaged, an the resulting modulus ($N/m^2 \times 10^9$) was adjusted to a conditioned RH of 22%.

Density measurements were taken using calibrated density gradient columns of tetrachloroethylene and heptane. Measurements were not corrected for additive or monomer.

In order to determine percent crystallinity (XTAL) crystalline orientation (f_c), x-ray measurements were taken on a Siemens D-500 x-ray Diffraction unit, which was interfaced to a HP85 computer. Crystalline orientation functions were determined from x-ray azimuthal scans. Crystallinity values were determined from the relative percent of alpha crystal structure from x-ray together with the density measurements.

The amorphous orientation function (f_aB_{ir}) was determined from the birefringence data using 0.069 as the intrinsic birefringence for both the crystalline and amorphous phases according to the following equations:
where:

$$\Delta n = \beta f_c \Delta n_c^o + (1-\beta) f_a \Delta n_a^o$$

Δn =	measured birefringence
β =	percent crystallinity
f_c =	crystalline orientation
Δn_a^o =	intrinsic birefringence for the crystalline phase
Δn_a^o =	intrinsic birefringence for the amorphous phase

In order to determine the crystalline size, equatorial x-ray diffraction peak widths at half peak height were used to estimate the gamma crystalline size.

TABLE I

EXAMPLE #	ADDITIVE TYPE	AMOUNT	RV	% ELONGATION	L-10 (gms)	DRAW RATIO	WINDER SPEED (M/MIN)	CHIP TYPE	FILAMENT TYPE (1) (40 denier = 4.444 tex)
1	CONTROL	-0-	2.79	69	40	1.05	4750	B300	40/12R
2	H_2O	0.5%	2.61	63	44	1.05	4750	B300	40/12R
3	H_2O	1.0%	2.42	55	50	1.05	4750	B300	40/12R
4	H_2O	1.5%	2.24	51	55	1.05	4750	B300	40/12R
5	CONTROL	-0-	2.72	70	37	1.05	4750	B300	40/12R
6	Benzyl Alcohol	1%	2.65	63	39	1.05	4750	B300	40/12R
7	Benzyl Alcohol	2%	2.52	57	45	1.05	4750	B300	40/12R
8	Benzyl Alcohol	3%	2.40	56	49	1.05	4750	B300	40/12R
9	Benzyl Alcohol	4%	2.37	50	53	1.05	4750	B300	40/12R
10	CONTROL	-0-	2.75	68	37	1.05	4750	B300	40/12R
11	Triethyleneglycol	0.5%	2.65	66	44	1.05	4750	B300	40/12R
12	Triethyleneglycol	1.0%	2.59	62	48	1.05	4750	B300	40/12R
13	Triethyleneglycol	2.0%	2.42	58	51	1.05	4750	B300	40/12R
14	Triethyleneglycol	3.0%	2.40	54	53	1.05	4750	B300	40/12R
15	Pentaerythritol	1.0%	2.45	56	52	1.05	4750	B300	40/12R
16	Pentaerythritol	2.0%	2.27	54	58	1.05	4750	B300	40/12R
17	Benzoin	3.2%	2.31	55	54	1.05	4750	B300	40/12R
18	Benzoin	4.9%	2.24	51	54	1.05	4750	B300	40/12R
19	Chlorobenzoic acid	0.5%	2.50	61	45	1.05	4750	B300	40/12R
20	Lauric Acid	0.7%	2.25	55	55	1.05	4750	B300	40/12R
21	CONTROL	-0-	3.0	51	71	1.30	4750	B35	40/12R
22	Benzyl Alcohol	1.0%	N/A	49	73	1.30	4750	B35	40/12R
23	Benzyl Alcohol	3.0%	2.7	41	88	1.30	4750	B35	40/12R
24	Benzyl Alcohol	5.0%	2.4	31	95	1.30	4750	B35	40/12R
25	Benzyl Alcohol	7.0%	2.36	30	99	1.30	4750	B35	40/12R
26	CONTROL	-0-	3.3	49	73	1.30	4750	B35	40/12R
27	H_2O	0.75%	2.9	46	82	1.30	4750	B35	40/12R
28	H_2O	1.5%	2.7	42	89	1.30	4750	B35	40/12R
29	H_2O	1.8%	2.6	39	96	1.30	4750	B35	40/12R
30	H_2O	N/A	2.5	37	96	1.30	4750	B35	40/12R
31	CONTROL	-0-	2.31	54	49	1.05	4750	B3S	40/12R
32	H_2O	1.0%	2.14	50	51	1.05	4750	B3S	40/12R

(1) total denier/number of filaments

33	CONTROL	-0-	2.31	45	77	1.20	4750	B3S	40/12R
34	H_2O	1.0%	2.14	36	84	1.20	4750	B3S	40/12R
35	CONTROL	-0-	2.48	71	35	1.05	4750	AS503	40/12R
36	Triethylene glycol	0.75%	2.30	65	37	1.05	4750	AS503	40/12R
37	CONTROL	-0-	2.37	62	41	1.00	5000	B216	40/12R
38	H_2O	0.25%	2.36	59	45	1.00	5000	B216	40/12R
39	H_2O	0.34%	2.29	59	46	1.00	5000	B216	40/12R
40	H_2O	0.47%	2.26	56	46	1.00	5000	B216	40/12R
41	CONTROL	-0-	2.43	60	42	1.00	5000	B216	40/28T
42	H_2O	0.48%	2.26	57	45	1.00	5000	B216	40/28T
43	H_2O	0.75%	2.20	52	47	1.00	5000	B216	40/28T
44	H_2O	0.98%	2.13	53	48	1.00	5000	B216	40/28T
45	CONTROL	-0-	2.36	58	45	1.00	5250	B216	40/28T
46	H_2O	0.48%	2.30	56	45	1.00	5250	B216	40/28T
47	CONTROL	-0-	2.78	59	51	1.14	4300	B300	40/12R
48	H_2O	0.5%	2.66	54	59	1.14	4300	B300	40/12R
49	H_2O	1.0%	2.53	51	66	1.14	4300	B300	40/12R
50	H_2O	1.5%	2.46	51	64	1.14	4300	B300	40/12R
51	CONTROL	-0-	2.78	59	51	1.14	4300	B300	40/12R
52	Triethylene glycol	1.0%	2.55	53	58	1.14	4300	B300	40/12R
53	Triethylene glycol	2.0%	2.53	52	63	1.14	4300	B300	40/12R
54	Triethylene glycol	3.0%	2.45	49	63	1.14	4300	B300	40/12R
55	CONTROL	-0-	2.60	45	85	1.20	5660	B300	40/12R
56	H_2O	0.5%	2.54	38	102	1.20	5660	B300	40/12R
57	H_2O	0.75%	2.47	35	118	1.20	5660	B300	40/12R
58	Benzyl Alcohol	4.2%	2.42	36	112	1.30	4750	B300	40/12R
59	Benzyl Alcohol	4.2%	2.42	23	136	1.45	4750	B300	40/12R
60	CONTROL	-0-	2.75	63	42	1.00	5250	B300	40/12R
61	H_2O	1.0%	2.31	54	50	1.00	5250	B300	40/12R
62	CONTROL	-0-	2.74	70	37	1.00	4000	B300	40/12R
63	H_2O	0.21%	2.61	67	39	1.00	4000	B300	40/12R
64	H_2O	0.24%	N/A	63	43	1.00	4000	B300	40/12R
65	H_2O	0.39%	2.46	62	47	1.00	4000	B300	40/12R
66	H_2O	0.50%	2.42	62	47	1.00	4000	B300	40/12R
67	H_2O	0.56%	2.40	59	52	1.00	4000	B300	40/12R
68	H_2O	0.98%	2.31	61	45	1.00	4000	B300	40/12R
69	H_2O	1.50%	2.22	expands off bobbin		1.00	4000	B300	40/12R

70	CONTROL	-0-	2.74	66	45	1.07	4000	B300	40/12R
71	H_2O	0.21%	2.61	61	52	1.07	4000	B300	40/12R
72	H_2O	0.24%	N/A	60	54	1.07	4000	B300	40/12R
73	H_2O	0.39%	2.48	57	56	1.07	4000	B300	40/12R
74	H_2O	0.50%	2.42	59	57	1.07	4000	B300	40/12R
75	H_2O	0.56%	2.40	57	55	1.07	4000	B300	40/12R
76	H_2O	0.98%	2.31	60	52	1.07	4000	B300	40/12R
77	H_2O	1.50%	2.22	59	49	1.07	4000	B300	40/12R
78	H_2O	1.68%	2.18	57	48	1.07	4000	B300	40/12R
79	CONTROL	-0-	2.74	61	52	1.13	4000	B300	40/12R
80	H_2O	0.21%	2.61	59	56	1.13	4000	B300	40/12R
81	H_2O	0.24%	N/A	57	59	1.13	4000	B300	40/12R
82	H_2O	0.39%	2.48	58	58	1.13	4000	B300	40/12R
83	H_2O	0.50%	2.42	57	59	1.13	4000	B300	40/12R
84	H_2O	0.56%	2.40	55	61	1.13	4000	B300	40/12R
85	H_2O	0.98%	2.31	56	56	1.13	4000	B300	40/12R
86	H_2O	1.50%	2.22	60	49	1.13	4000	B300	40/12R

TABLE II

POLYMERS USED IN EXAMPLES

TiO_2 (%)	DESIGNATED CHIP TYPE	CHEMICAL SPECIES	RELATIVE VISCOSITY	AMINO END GROUPS (meq/kg)	CARBOXYLIC END GROUPS (meq/kg)	METHANOL EXTRACTABLES (%)	H_2O (%)
0	B300	polycaprolactam	2.75	34	55	0.42	
1.6	B216	polycaprolactam	2.36	29.5	67.8	0.44	.08
0.009	B3S	polycaprolactam	2.61	54.6	55.6		.09
0.008	B35	polycaprolactam	3.2	38.5	31.7	1.0	
0.298	AS503	polyhexamethylene adipimide	2.51	49.9			

TABLE III

IMPROVED DYE WASHFASTNESS AFTER 5 MACHINE WASHINGS

SAMPLE NUMBER	KITON ACID DYE ΔE CIELAB NORMALIZED TO CONTROL SAMPLE	CELANTHRENE DISPERSE DYE ΔE CIELAB NORMALIZED TO CONTROL SAMPLE	ORTOLON PREMETALLIZED DYE ΔE CIELAB NORMALIZED TO CONTROL SAMPLE
14 (CONTROL)	1.00	1.00	
15	1.39	1.32	
16	1.41	1.31	
17	1.69	1.24	
18	1.52	1.47	
19	1.10	1.33	
20	1.61	1.53	
31 (CONTROL)	1.00	1.00	1.00
32	1.18	1.26	2.88
33 (CONTROL)	1.00	1.00	1.00
34	1.05	1.17	1.16

TABLE IV

	without mixers	with 26 4x4 Ross ISG's
RV range	0.08	0.01
Amino End Group Range (meq/kg)	2.5	0.3
Kiton Dye Junction* Range	5	0-1
Warping Defects per Million End Yarns	280	<0.3

*A dye junction is the minimal visual difference in dye depth discernable to the human eye.

TABLE V
USE OF ADDITIVES IN A CLASSICAL 2-STAGE PROCESS
(i.e. spin lag draw)

EXAMPLE NUMBER	% H_2O	RV	AMINO END GROUPS (meq/Kg)	CARBOXYL END GROUPS (meq/Kg)	% EXTRACT IN MeOH	SPINNING SPEED (M/MIN)	DRAW* RATIO (%)	ELONGATION (%)	L-10 BREAKING LOAD 10% ELONG. (gm)	NORMALIZED ΔE CIELAB FOR KITON DYE AFTER ONE WASHING
87	-0- (Control)	2.80	32.1	54.3	1.58	800	2.70	46.8±5.7	108±13	1.00
88	0.37	2.75	33.1	54.4	1.65	800	2.70	50.5±4.6	100±11	1.02
89	0.74	2.67	35.1	55.4	1.81	800	2.70	54.9±2.1	100±3	0.92
90	1.48	2.50	43.4	65.0	1.91	800	2.70	61.8±4.8	84±1	0.88
91	2.21	2.34	48.7	70.0	1.76	800	2.70	61.2±7.7	77±4	0.91
92	2.95	2.33	51.3	72.2	1.80	800	2.70	67.8±8.0	75±2	0.92

*Draw ratio set to yield approximately 50% elongation for the control example (87).

TABLE VI

UNIFORMITY OF DRY YARN CHEMICAL PROPERTIES

ADDITIVE TYPE	AMOUNT	CHIP TYPE	RV	YARN CHEMICAL PROPERTIES AMINO END GROUPS (Meq/kg)	METHANOL EXTRACTABLES (%)
H_2O	1.5%	B300	2.46±.01	44.5±0.3	1.65±.08
Triethylene-Glycol	3.0%	B300	2.45±.01	42.9±0.2	2.81±0.14
H_2O	0.5%	B216	2.28±.01	36.5±0.4	1.45±0.24

TABLE VII

POLYMER ORIENTATION

EXAMPLE NO.	BIREFRINGENCE	SONIC MODULUS ($N/m^2 \times 10^9$)	DENSITY (g/cc)	%XTAL	f_c	f_a Bir	SIZE EQUITORIAL (A)	%γ
10 (control)	0.0346	4.65	1.1285	46	0.86	0.20	56.1	91
15	0.0358	4.78	1.1300	48	0.87	0.20	49.7	100
16	0.0377	4.80	1.1285	46	0.86	0.28	43.1	89
51 (control)	0.0368	4.42	1.1305	51	0.82	0.24	32	75
52	0.0381		1.1305	51		0.28	31	75
53	0.0384		1.1310	50		0.30	30	70
54	0.0394		1.1315	50		0.32	29	69

Claims

1. A melt-spinning process for the production of polyamide filaments characterised by the steps of:
   (a) Mixing an additive into a melt-spinnable polyamide polymer, so that the resulting polymer mix is homogenous, the additive having a molecular weight less than 400 and being a member selected from the group consisting of water, alcohols, and organic acids, the additive being mixed in an amount so that on extrusion, the molten polymer mix has a relative viscosity between 2.0 and 3.0 as measured in 96% sulphuric acid) and, when it is water, the additive being present in the mix in an amount greater than 0.15% by weight;
   (b) extruding the resulting molten polymer mix through a spinnerette so that polyamide filaments are formed;
   (c) quenching the so formed filaments; and
   (d) taking up the quenched filaments at a speed which is greater than 3200 meters per minute.

2. A process as claimed in Claim 1 characterised in that the resulting filaments have a tex (denier) per filament of less than 1.333 (12).

3. A process as claimed in claim 1 or 2, wherein the resulting filaments have a tex (denier) per filament of less than 0.388 (3.5).

4. A process as claimed in any of Claims 1 to 3, wherein the additive is water and the polymer is polycaprolactam.

5. A process as claimed in Claim 4 characterised in that on extrusion the relative viscosity of the molten polymer mix is between 2.2 and 2.6.

6. A process as claimed in any of claims 1 to 5 charcterised in that the filaments are drawn to a draw ratio between 1.02 and 3.0.

7. A process as claimed in claim 6, characterised in that the drawn ratio is between 1.02 and 1.45.

8. An improved polycaprolactam filament, the improved filament exhibiting an improved washfastness, the improved washfastness being exhibited by the filament having a normalized Δ E (CIELAB) greater than 1.0, 1.0 being the Δ E (CIELAB) of a filament produced according to a method which differs from the method of Claim 1 in omitting the mixing of the additive into the melt-spinnable polymer.

Revendications

1. Procédé de filage à l'état fondu pour la production de fibres de polyamide, procédé caractérisé en ce qu'il comprend les différentes étapes consistant à :
   (a) mélanger un additif à un polymère de polyamide filable à l'état fondu, de façon que le mélange de polymère obtenu soit homogène, l'additif présentant un poids moléculaire inférieur à 400 et consistant en un élément choisi dans le groupe comprenant l'eau, les alcools et les acides organiques, cet additif étant mélangé dans une proportion telle qu'à l'extrusion le mélange de polymère fondu présente une viscosité relative comprise entre 2,0 et 3,0 lorsqu 'elle est mesurée dans de l'acide sulfurique à 96 %, et l'additif, lorsqu'il s'agit de l'eau, étant présent dans le mélange en proportion supérieure à 0,15 % en poids;
   (b) extruder le mélange de polymère fondu obtenu à travers une filière de manière à former des fibres de polyamide ;
   (c) tremper les fibres ainsi formées ; et
   (d) enrouler les fibres trempées à une vitesse supérieure à 3.200 mètres par minute.

2. Procédé selon la revendication 1, caractérisé en ce que les fibres obtenues présentent une valeur de tex (denier) par fibre de moins de 1,333 (12).

3. Procédé selon l'une quelconque des revendications 1 et 2, caractérisé en ce que les fibres obtenues présentent une valeur de tex (denier) par fibre de moins de 0,388 (3,5).

4. Procédé selon l'une quelconque des revendications 1 a 3, caractérisé en ce que l'additif est de l'eau et en ce que le polymère est du polycaprolactam.

5. Procédé selon la revendication 4, caractérisé en ce qu'à l'extrusion, la viscosité relativement du mélange de polymère fondu est comprise entre 2,2 et 2,6.

6. Procédé selon l'une quelconque des revendications 1 à 5, caractérisé en ce que les fibres sont étirées avec un taux d'étirage compris entre 1,02 et 3,0.

7. Procédé selon la revendication 6, caractérisé en ce que le taux d'étirage est compris entre 1,02 et 1,45.

8. Fibre de polycaprolactam perfectionnée, cette fibre perfectionnée présentant une solidité au lavage améliorée, cette solidité au lavage étant présentée par la fibre de Δ E normalisé (CIELAB) supérieur à 1,0, ce 1,0 étant le Δ E (CIELAB) d'une fibre produite par un procédé différent de celui de la revendication 1 en ce qu'on supprime le mélange de l'additif au polymère filable à l'état fondu.

Patentansprüche

1. Schmelzspinnverfahren zur Herstellung von Polyamidfilamenten, gekennzeichnet durch folgende Schritte:

(a) Einmischen eines Zusatzmittels in ein schmelzspinnbares Polyamidpolymer, so daß das erhaltene Polymergemisch homogen ist, wobei das Zusatzmittel ein Molekulargewicht von weniger als 400 aufweist und ausgewählt wurde aus der Gruppe bestehend aus Wasser, Alkoholen und organischen Säuren, und wobei das Zusatzmittel in einer Menge eingebracht wird, so daß bei Extrusion das geschmolzene Polymergemisch eine relative Viskosität zwischen 2,0 und 3,0 (gemessen in 96% Schwefelsäure) aufweist, und, wenn das Zusatzmittel Wasser ist, es in dem Gemisch in einer Menge von mehr als 0,15 Gewichtsprozent vorhanden ist;
(b) Extrudieren des erhaltenen geschmolzenen Polymergemisches durch eine Spinndüse, so daß Polyamidfilamente gebildet werden;
(c) Abschrecken der derart gebildeten Filamente; und
(d) Aufwickeln der abgeschreckten Filamente mit einer Geschwindigkeit von mehr als 3200 Metern pro Minute.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die erhaltenen Filamente ein Tex (Denier) von weniger als 1,333 (12) pro Faden aufweisen.

3. Verfahren nach Anspruch 1 oder 2, worin die erhaltenen Filamente ein Tex (Denier) von weniger als 0,388 (3,5) pro Filament aufweisen.

4. Verfahren nach einem der Ansprüche 1 bis 3, worin das Zusatzmittel Wasser und das Polymer Polykaprolaktam ist.

5. Verfahren nach Anspruch 4, dadurch gekennzeichnet, daß bei Extrusion die relative Viskosität des geschmolzenen Polymergemisches zwischen 2,2 und 2,6 beträgt.

6. Verfahren nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß die Filamente auf ein Streckverhältnis zwischen 1,02 und 3,0 gestreckt werden.

7. Verfahren nach Anspruch 6, dadurch gekennzeichnet, daß das Streckverhältnis zwischen 1,02 und 1,45 beträgt.

8. Verbessertes Polykaprolaktamfilament, wobei das verbesserte Filament eine verbesserte Waschechtheit aufweist und sich die verbesserte Waschechtheit in dem Filament durch einen normierten E (CIELAB) größer 1,0 zeigt, wobei 1,0 der E (CIELAB) eines Filaments ist, das nach einem Verfahren hergestellt wurde, das sich von dem Verfahren aus Anspruch 1 dadurch unterscheidet, daß es ohne Einrühren von Zusatzmittel in das schmelzspinnbare Polyme ausgeführt wurde.

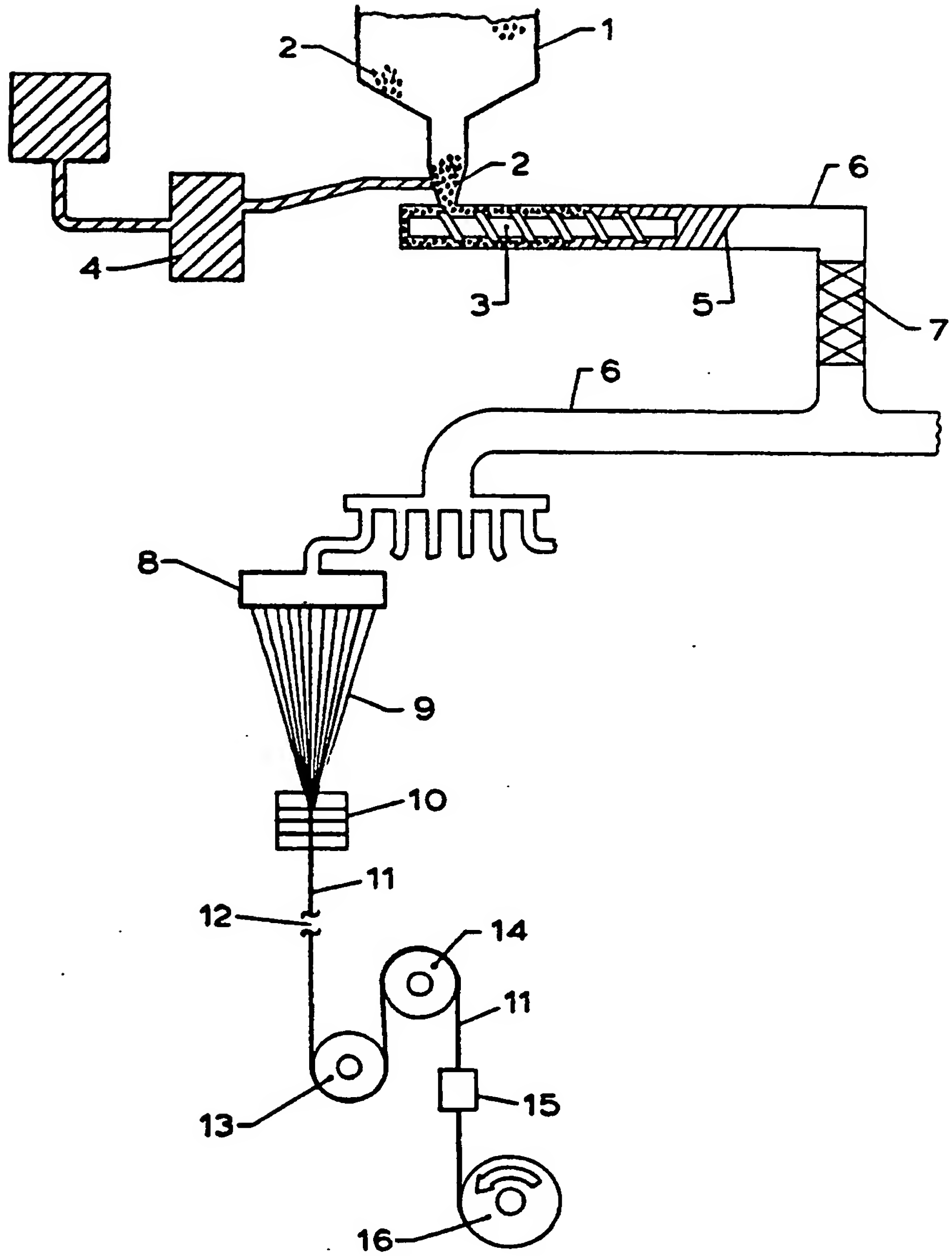

FIGURE 1

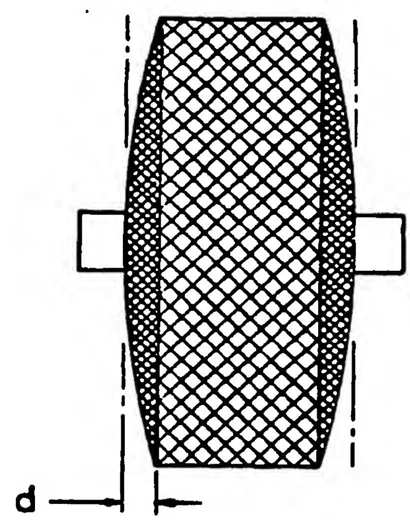

FIGURE 2

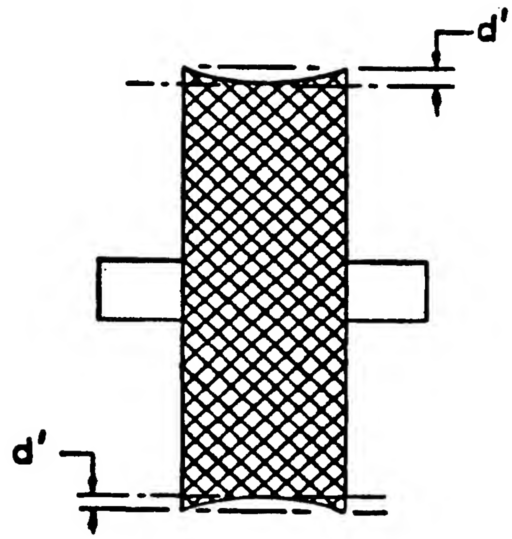

FIGURE 3

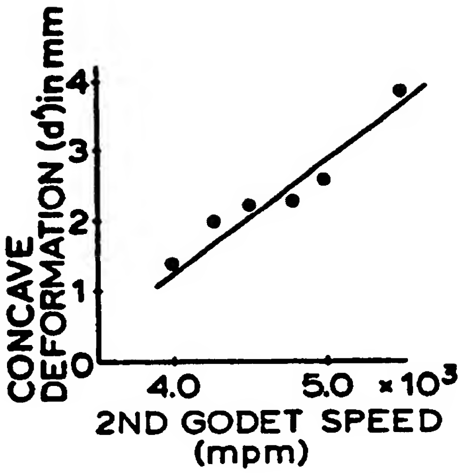

FIGURE 4

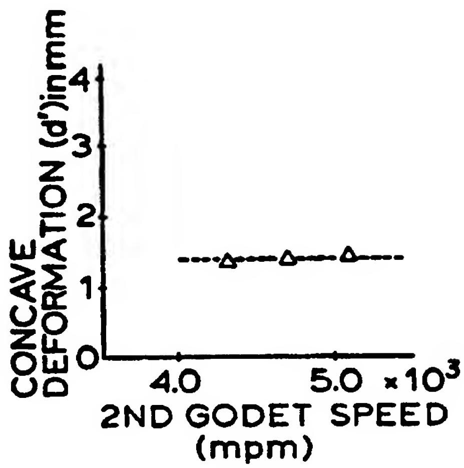

FIGURE 5

KEY for FIGS. 4 - 6

	CHIP	DRAW	ADDITIVE	DEN/FIL
•	B300	1.0	NONE	3.3
△	B300	1.0	H_2O	3.3
○	B216	1.0	H_2O	3.3
×	B216	1.0	H_2O	1.4

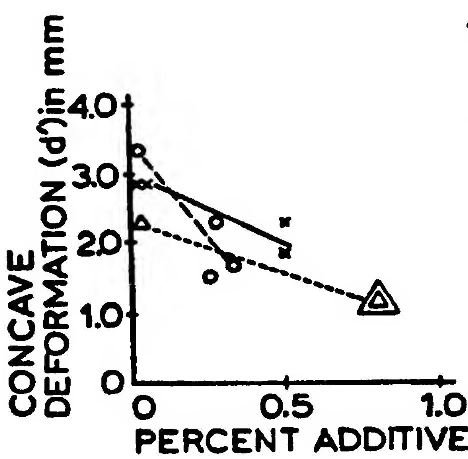

FIGURE 6

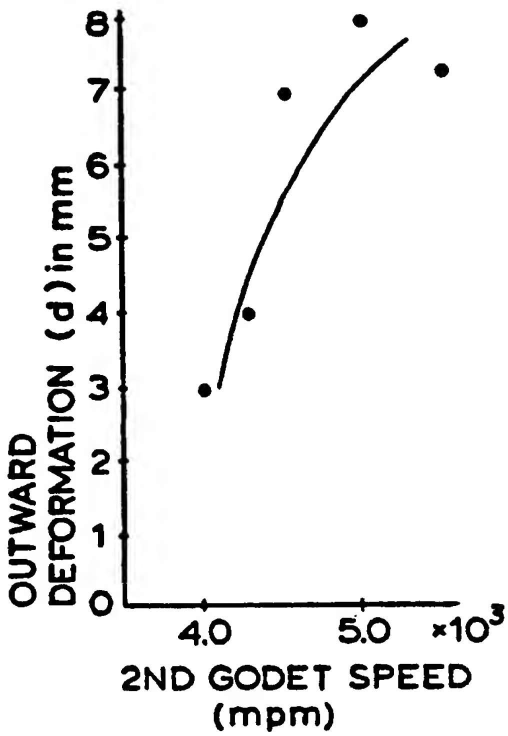

FIGURE 7

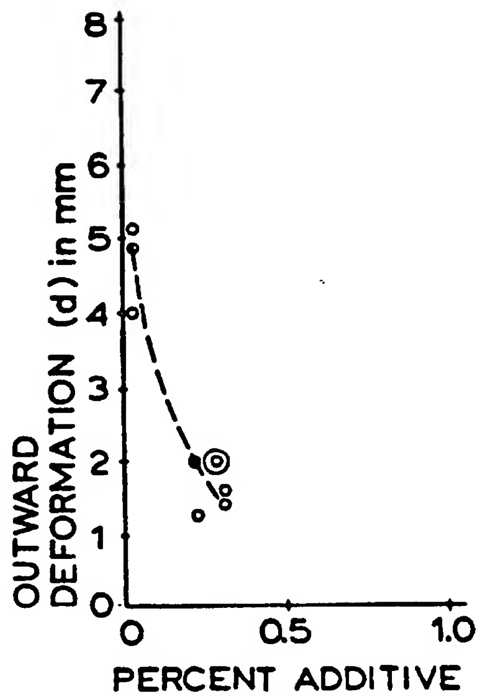

FIGURE 8

KEY for FIGS. 7&8

	CHIP	DRAW	ADDITIVE	DEN/FIL	TAKE UP SPEED
•	B300	1.0	H_2O	3.3	—
∘	B216	1.0	H_2O	3.3	5000